Notice of Allowability	Application No.	Applicant(s)	
	09/673,435	HEISS ET AL.	
	Examiner	Art Unit	
	Dmitry Levitan	2616	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *08/24/06*.

2. ☒ The allowed claim(s) is/are *25, 30-34, renumbered as 1, 2, 5, 6, 3, 4*.

3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☒ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☒ Other *Attachments A and B*.

Amendment, filed 08/24/06, has been entered.

Allowable Subject Matter

Claims 25, 30-34 allowed.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Kevin Spivak on 09/26/06.

The application has been amended as follows:

2. Specification has been replaced per Attachment A.

3. The following changes to the drawings have been approved by the examiner and agreed upon by applicant: the drawings have been replaced per Attachment B.

Note. The drawings and specification have been amended to exclude new matter, introduced by previous amendments, and return the specification and drawings to the original version, as filed on 10/18/00.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dmitry Levitan whose telephone number is (571) 272-3093. The examiner can normally be reached on 8:30 to 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Doris To can be reached on (571) 272-7529. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Dmitry Levitan
Examiner
Art Unit 2616

Attachment A.

METHOD FOR REMOVAL OF ATM CELLS FROM AN ATM COMMUNICATIONS DEVICE

CLAIM FOR PRIORITY

This application is a continuation application of U.S. Patent Application No. 09/673,435, filed October 18, 2000, which is a national stage of International Application No. PCT/EP99/01986, which was published in the German language on December 9, 1999, which claims the benefit of priority to European Application No. 98109876.7 which was filed in the German language on May 29, 1998.

TECHNICAL FIELD OF THE INVENTION

The invention relates to a method for a removal of ATM cells from an ATM communications device.

BACKGROUND OF THE INVENTION

In conventional packet communications systems, a packet has a comparatively large and variable length. One system for transmitting information in packets with fixed, predetermined lengths is referred to as the ATM (Asynchronous Transfer Mode) system. Such a system allows voice, video and data signals to be processed and transmitted in the same way. The individual packets are normally called cells. The cells each contain a cell header, whose information allows switching and/or assignment of the respective cell. In ATM communications devices, in particular communications network devices, high-speed and broadband transmission is possible at a transmission rate of more than 150 Mb/s.

One problem with ATM communications devices is the level of the transmission rate on a transmission path when a jam of ATM cells has formed there. This problem is described in detail in the German Patent Application

19810058.2, corresponding to U.S. Serial No. 09/623,775, filed September 8, 2000. This refers to ATM systems in which a plurality of ATM cells are in each case assigned to a common frame. These frames are data packets of variable length, in a relatively narrow sense. If, for example, a cell in such a frame is lost or has been damaged, it is undesirable for the remaining cells in the same frame to be transmitted further over a transmission path of an ATM device, since the complete information in the frame would no longer be received at the end of the transmission path. The ATM system would thus be unnecessarily loaded dynamically. Particularly when a jam occurs on the transmission path, it is necessary to remove the remaining cells in the frame as quickly and effectively as possible.

It has thus been proposed for ATM cells in a specific frame to be removed in each case when an individual ATM cell arrives at the end of a queue. Such queues are used, in particular, to control a sequence of ATM cells at the end and/or at the start of a transmission path. According to a method which is described in the above-mentioned Patent Application and which is called Partial Packet Discard (PPD in the following text), the first and, if present, other cells in the frame which are already located in the queue are not removed, but only all the newly arriving cells in the frame, with the exception of the last cell of the frame. The PPD method has the disadvantage that at least the first and the last cell in the frame still have to remain in the queue.

The abovementioned Patent Application discloses a further method, according to which all the cells in a frame, from the first cell to the last cell, are removed from the ATM communications device upon arrival in a queue. This method, which is called Early Packet Discard

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(EPD in the following text), has the advantage that no residual cells remain from a damaged frame, or from a frame which is to be removed for other reasons, and the maximum possible space is thus available for other ATM cells. However, the EPD method cannot be applied to frames whose first cell has already been added to the queue.

The transmission of information using the Internet is an example of communication networks via which information is transmitted in packets with a comparatively large and variable length. The Internet protocol TCP/IP is used in this case, which supports the transmission of frames with a variable length. In practice, these networks have an interface to ATM networks. For this reason, the information contained in data packets has to be converted to ATM cells, and vice versa.

For this purpose a frame initial code, for example, is stored which denotes that ATM cell immediately in front of the first ATM cell of the frame in the queue. This information normally exists in the cell header of the last cell of the frame, namely, as a rule, in the so-called AAU bit in the cell type field (payload type field) of the cell header. Furthermore, the ATM cells are numbered so that, in the end, the majority of the ATM cells can be assigned to a data packet.

German Patent Application 198 100 58.2 describes a further method for how ATM cells can be removed when overload situations occur in a frame. This method, which is also called the LPD method, is particularly useful when a decision has been made to discard the second part of the frame while the first part is still located in the queue in the ATM system. In this case, the first part of the frame is removed from the queue, and the remaining cells are dealt with in the same way as in the EPD

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method. However, the problem arises here of inefficient handling of the cells in an overload situation.

SUMMARY OF THE INVENTION

The invention provides a way of handling cells efficiently in an overload situation.

According to the method of the invention for removal of ATM cells from an ATM communications device, a plurality of ATM cells are provided, a plurality of which are in each case assigned to a common frame and which are stored in connection-specific queues. A first algorithm is provided by means of which, with the exception of a first and a last ATM cell in a frame, all newly arriving cells in the frame are removed. A second algorithm is provided by means of which all the ATM cells in a frame, from a first cell to a last cell, are removed on arrival in a queue from the ATM communications device. At a start of a transmission process, a user indicates a maximum number of ATM cells per frame, and the ATM cells using the number are transmitted when the maximum number is exceeded, the associated frame is discarded or the first algorithm is used.

An advantageous feature of the invention is, in particular, that rules are defined whose application results in the PPD method now being used to only a very limited extent.

The invention will be explained in more detail in the following text with reference to an exemplary embodiment.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 shows the first part of the algorithm which deals with the cells when cells arrive;

Fig. 2A shows the second part of the algorithm, which describes a decision function, on the basis of which the cells are discarded.

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which the cells are discarded ~~for high-priority cells~~.

Fig. 2B shows an algorithm, which describes a decision function for low-priority cells.

DETAILED DESCRIPTION OF THE INVENTION

Although various minor changes and modifications might be proposed by those skilled in the art, it will be understood that our wish is to include within the claims of the patent warranted hereon all such changes and modifications as reasonably come within our contribution to the art.

The invention is based on the assumption that ATM cells are fed to queues in an ATM communications device. Some of the cells are discarded, but the remaining cells leave the queues at a later time. Each connection has a specific maximum frame size MFS, which is measured in cells and which depends on the connection. Furthermore, it is assumed that the CLP bit in the cell type field (payload type field) of the cell header of the ATM cell is evaluated in the ATM node. The user can send information in high-priority and low-priority frames. The cells in the high-priority frames have CLP = 0 (not marked), while the cells with low-priority frames have CLP = 1 (marked).

In all the connections under consideration, it is assumed that the associated cells are organized in frames, with the AAU bit being set in the payload type field of the header of the last cell in the frame. All the cells should receive application-related information. Furthermore, all the ATM cells which are stored in queues should have queue-specific markings QID with the queues themselves being organized on a connection-specific basis. The queues are designed as a FIFO queue, in the form of an ordered list of ATM cells.

identification, which is denoted P_cell. In detail, the operations are:

Cell operations:

The following operations are carried out with ATM cells to which a valid cell identification number P_cell is assigned. In this case:

end_of_frame (P_cell)	is set to the value TRUE when the end of the frame is reached, otherwise, this variable is set to the value FALSE
Discard_cell (P_cell)	discards cells having the identification number P_cell
Decide_cell (P_cell)	designates the algorithm, as will be explained in more detail further below.

Operations on the queue data structure:

The following operations can be carried out in the queue:

append_cell (P_cell)	inserts the identification number P_cell at the end of a queue
remove_last_frame	the LPD algorithm discards all the cells in the frame in question the variable returns the value TRUE if the LPD algorithm can be applied to the connection, otherwise the value FALSE.

Operation in the buffer contents:

The following operations can be carried out in the buffer contents:

Buffer_check_0	returns the value TRUE when the

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	buffer contents indicate that high-priority frames (CLP = 0) should be discarded otherwise, FALSE is returned
Buffer_check_1	returns the value TRUE when the buffer contents indicate that low-priority frames (CLP = 1) should be discarded otherwise, FALSE is returned

Data structures in a queue:

There is an identification number QID for each connection and the queue associated with it. This is used for storing the following data:

- indication as to whether the variable "full packet discard" can be applied to the cells in the present frame (FPD_flag). This is equivalent to the statement that the LPD or EPD algorithm is used.
- indication as to whether the PPD algorithm is applied to the cells in the present frame (PPD_flag).
- the variable "logical queue length" denotes a cell counter which indicates the present number of cells in the queue.
- the variable S_EPD_0 denotes the fixed threshold of a queue for application of the EPD algorithm to low-priority cells
- the variable MFS denotes the maximum frame size
- the variable Current_frame_length denotes a cell counter which is incremented by 1 for non-discarded cells of the connection. The variable is reset when the last cell in a frame arrives.

Global constants:

The following global constants are used:

- the constant S_PPD_0 denotes a fixed upper limit for the queue (for all QIDs)

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- the constant S_EPD_1 denotes the fixed threshold for early packet discard for CLP1 cells (for all QIDs)

In other variants of the algorithm, the global constants may differ for different groups of connections, or they may be connection-specific.

The following initial values are assigned:

FPD_flag = FALSE

PPD_flag = FALSE

Current_frame_length = 0

Furthermore, the following relationships apply to the abovementioned constants:

S_EPD_1>0

S_PPD_1=S_EPD_1+MFS

S_EPD_0>S_PPD_1

S_PPD_0>S_EPD_0+MFS

The method according to the invention consists overall of 2 parts. In the first part, the algorithm starts to run when cells arrive, while in the second part a decision algorithm is controlled.

Figure 1 shows the algorithm which is run when an ATM cell arrives.

According to this, the FPD_flag is checked first of all. If the FPD_flag has assumed the value TRUE, the cell is rejected. If this cell was the last cell in the frame, the FPD algorithm is not used when the next cells arrive from the same connection. If the FPD_flag has assumed the value FALSE, the use of the PPD algorithm is checked. If the PPD algorithm is used, that cell which does not represent the last cell in a frame is always rejected. Otherwise, the cell is transferred to the queue, and the PPD algorithm is not used when a cell next arrives. When the PPD algorithm is not used, however, other acceptance algorithms can be controlled for a cell. For example, the function append_cell can be used, or the cell can be rejected.

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Figure 2 shows the decision algorithm. In this case a distinction is drawn between low-priority cells and high-priority cells.

For high-priority cells (CLP = 0), it can be said that:

If the cell in question is the first cell in the frame, a decision must first be made as to whether this cell and the remaining cells in the frame are discarded, or whether the cell is added to the queue. Reasons for discarding the frame are, for example, that the queue has less free cell memory space available than the amount MFS. Other reasons may be that the length of the queue is above the EPD_0 threshold and the status of the buffer store indicates at the same time that high-priority frames should be discarded.

If the cell is the only cell in the frame, it simultaneously represents the end of the frame and the FPD_flag is not set, otherwise it is set.

If the cell is not the first cell in the frame, one or more cells of the frame are added to the queue. Otherwise, the decide_cell function is not used. If it is the last cell in the frame, it is accepted in each case and added to the queue. If it is not the last cell in the frame, the cell is discarded if the following condition is satisfied:

At most one free memory space for a cell must be present in the queue or if the current length of the queue is above the threshold EPD_0 and the buffer store indicates that high-priority frames should be discarded or if the previous length of the frame is greater than the value MFS - 1. The reason for a free cell is to reserve sufficient memory space for the last cell in the frame. The reason for the value MFS - 1 is that the cell is not the last cell in the frame and, if the present length of the frame exceeds the value MFS - 1, the complete frame also exceeds the value MFS. If the cell is

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to be discarded, the first part of the frame should, if possible, be removed from the queue and the FPD_flag set. Otherwise, the PPD_flag is set.

For low-priority cells, that is to say cells which have the characteristic CLP = 1, the handling operations to be carried out are similar to those described above.In the case of low-priority cells, the algorithm appears as:

```
IF (CLP=1)                                  //comment: marked
frame
     THEN IF   (first cell of frame)        //e.g.
Current_frame_length=0
          THEN   IF        (Logical_queue_length≥S_PPD_1)OR
                 [(Logical_queue_length>S_EPD_1)AND
                 (Buffer_check_1=TRUE)]
            THEN discard_cell(P_cell)
                 IF        end_of_frame(P_cell)=FALSE
                 THEN FPD_flag=TRUE
            ELSE append_cell(P_cell)

          IF     (subsequent cell of frame)    //e.g.
Current_frame_length>0
          THEN   IF        end_of_frame(P_cell)
            THEN append_cell(P_cell)
            ELSE IF        (Logical_queue_length≥S_PPD_1-
1)OR

     [(Logical_queue_length>S_EPD_1)AND
                          (Buffer_check_1=TRUE)]OR
                          (Current_frame_length>MFS-1)
                 THEN     discard_cell(P_cell)
                          IFremove_last_frame
                          THEN      FPD_flag=TRUE
                          ELSE      PPD_flag=TRUE
                 ELSE     append_cell(P_cell)
```

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However, the thresholds are defined as below for low-priority cells:

The variable Logical_queue_length is the length of the queue on arrival of the cell, and the variable Current_frame_length indicates the value of the variable when cells arrive. Initially, the variable Current_frame_length is set to 0. It is incremented by 1 when a cell is added to the queue. It is set to 0 when the end of the frame has arrived or when the last frame has been removed from the queue using the LPD algorithm. The first cell in the frame is generally recognized by the variable Current_frame_length = 0.

Attachment B.

FIG 1

```
IF FPD_flag=TRUE
THEN   IF end_of_frame(P-cell)
       THEN FPD_flag=FALSE
       discard_cell(P_cell)
ELSE   IF PPD_flag=TRUE
       THEN IF end_of_frame(P_cell)
            THEN append_cell(P_cell)
                 PPD_flag=FALSE
            ELSE discard_cell(P_cell)
       ELSE   decide_cell(P_cell)
```

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Inventor: Herbert HEIB
Atty Docket No. 44912-2031200

REPLACEMENT SHEET

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FIG 2A

```
IF      (CLP=0)                                  //comment: unmarked frame
THEN    IF      (first cell of frame)            // e.g. Current_frame_length=0
        THEN IF     (Logical_queue_length>S_PPD_0-MFS)OR
                    [(Logical_queue_length>S_EPD_0)AND
                    (Buffer_check_0=TRUE)]
             THEN discard_cell(P_cell)
                  IF     end_of_frame(P_cell)=FALSE
                  THEN FPD_flag=TRUE
             ELSE append_cell(P_cell)

IF      (subsequent cell of frame) //e.g. Current_frame_length >0
THEN IF     end_of_frame(P_cell)
     THEN append_cell(P_cell)
     ELSE IF     (Logical_queue_length≥S_PPD_0-1)OR
                 [(Logical_queue_length>S_EPD_0)AND
                 (Buffer_check_0=TRUE)]OR
                 (Current_frame_length>MFS-1)
          THEN discard_cell(P_cell)
               IF     remove_last_frame
               THEN FPD_flag=TRUE
               ELSE PPD_flag=TRUE
          ELSE append_cell(P_cell)
```

USSN 09/673,435; filed October 18, 2000
Inventor: Herbert HEIB
Atty Docket No. 44912-2031200

REPLACEMENT SHEET

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FIG 2B

```
IF      (CLP=1)
THEN    IF    (first cell of frame)                 //comment: marked frame
                                     //e.g. Current_frame_length=0
        THEN IF   (Logical_queue_length≥S_PPD_1)OR
                  [(Logical_queue_length>S_EPD_1)AND
                  (Buffer_check_1=TRUE)]
             THEN discard_cell(P_cell)
                  IF    end_of_frame(P_cell)=FALSE
                  THEN  FPD_flag=TRUE
             ELSE append_cell(P_cell)

        IF    (subsequent cell of frame)  //e.g. Current_frame_length>0
        THEN IF    end_of_frame(P_cell)
             THEN append_cell(P_cell)
             ELSE IF   (Logical_queue_length≥S_PPD_1-1)OR
                       [(Logical_queue_length>S_EPD_1)AND
                       (Buffer_check_1=TRUE)]OR
                       (Current_frame_length>MFS-1)
                  THEN discard_cell(P_cell)
                       IF    remove_last_frame
                       THEN  FPD_flag=TRUE
                       ELSE  PPD_flag=TRUE
                  ELSE append_cell(P_cell)
```